

# Airborne Digital Imaging for Spill Prevention & Response



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# Overview

## Applications : Technologies

- **Kelp Mapping** : Digital Multi-Spectral Video
- **Incident Response** : Digital-Still Imaging
- **Code Enforcement** :
- **Response Planning**: Video/GPS Recon

# Previous Work

- DFG Air Services aerial photography (ca. 1950's – 1980's)
- Digitization of Aerial Photography (Kelp Surveys, 1989 EcoScan, 1999 DFG)
- Federal/State Efforts
- NASA/CDF (Wildland Fire/RealTime Data)
- USDI/MMS – Environment Canada (Laser Fluorospectrometry)



Fish and Game -- Partenavia P6 -- Recon Aircraft

California bases: Sacramento, Hemet, Fresno, Redding

- **Kelp Mapping : Digital Multi-Spectral Video**

- Incident Response : Digital-Still Imaging  
with GPS Integration  
  
Georeferencing
- Code Enforcement : Change Detection
- Response Planning: Video / GPS Recon

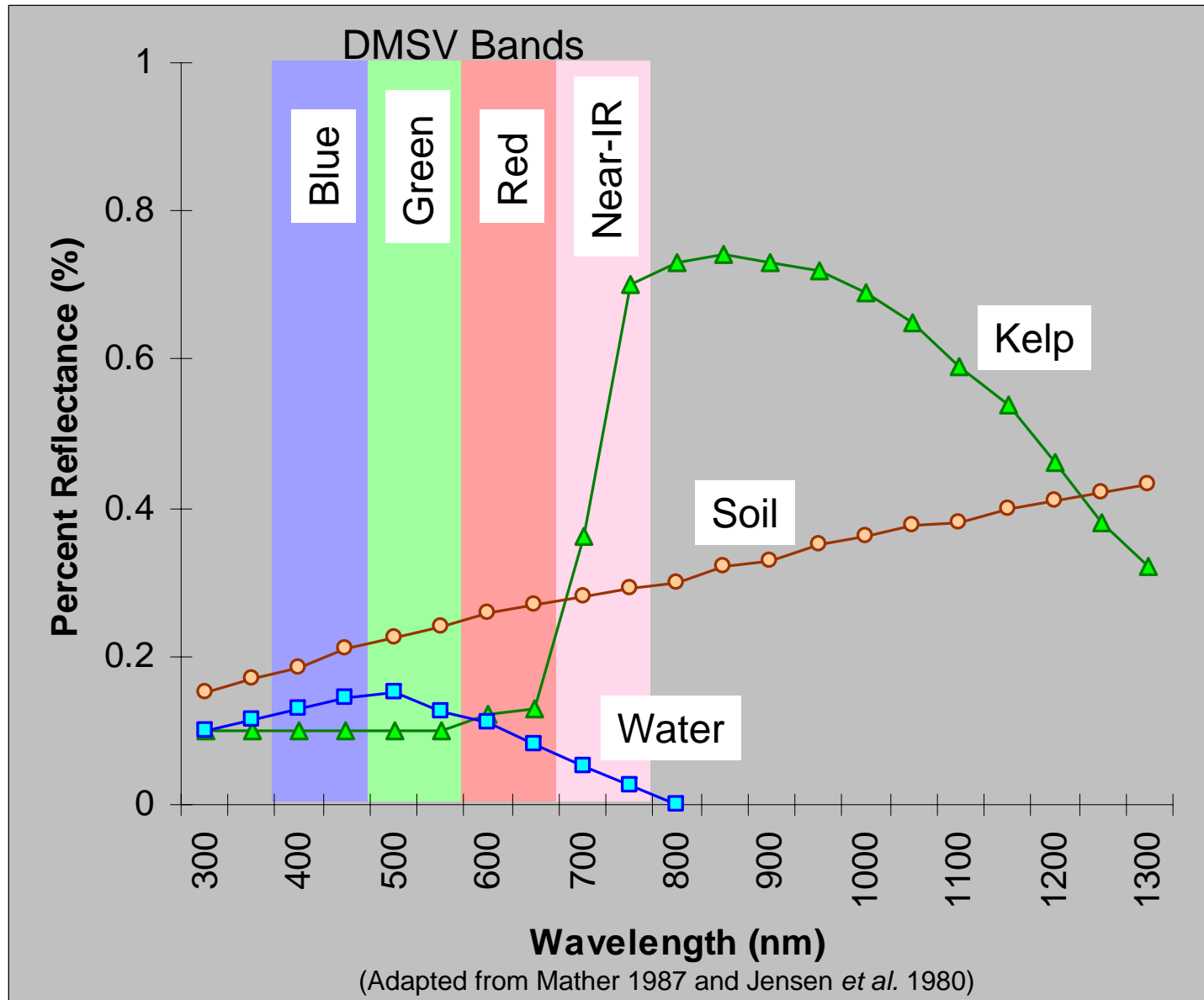


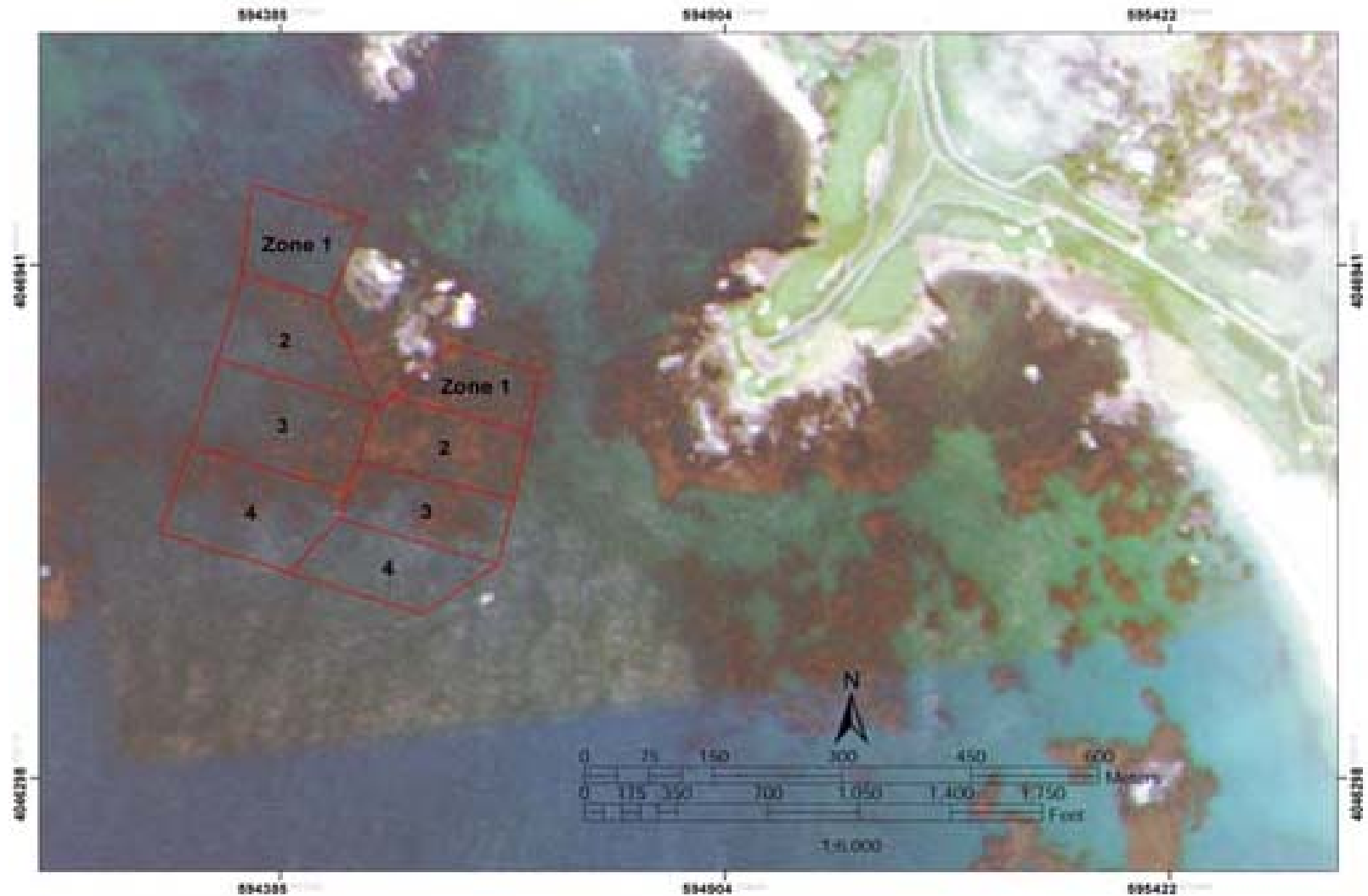
# Digital Multi-Spectral Video

- DMSV: 4 – band color  
Blue : 450 nm  
Green : 550  
Red : 650  
Near-IR : 750
- CCD : 740 x 578
- 2m Pixel @ 11,000 ft.



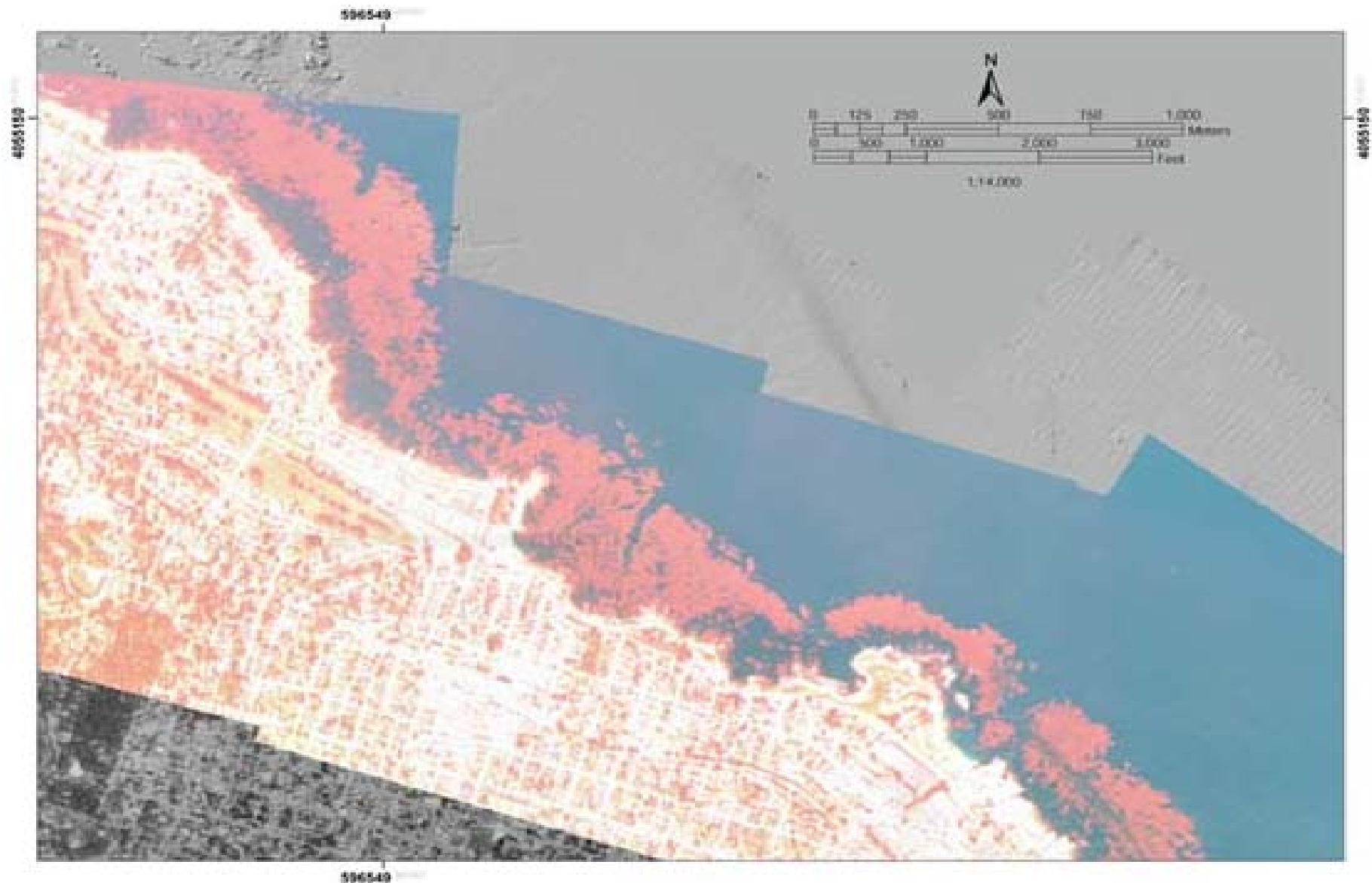
# Spectral Reflectance Characteristics of Kelp (*Macrocystis pyrifera*), Water, and Soil



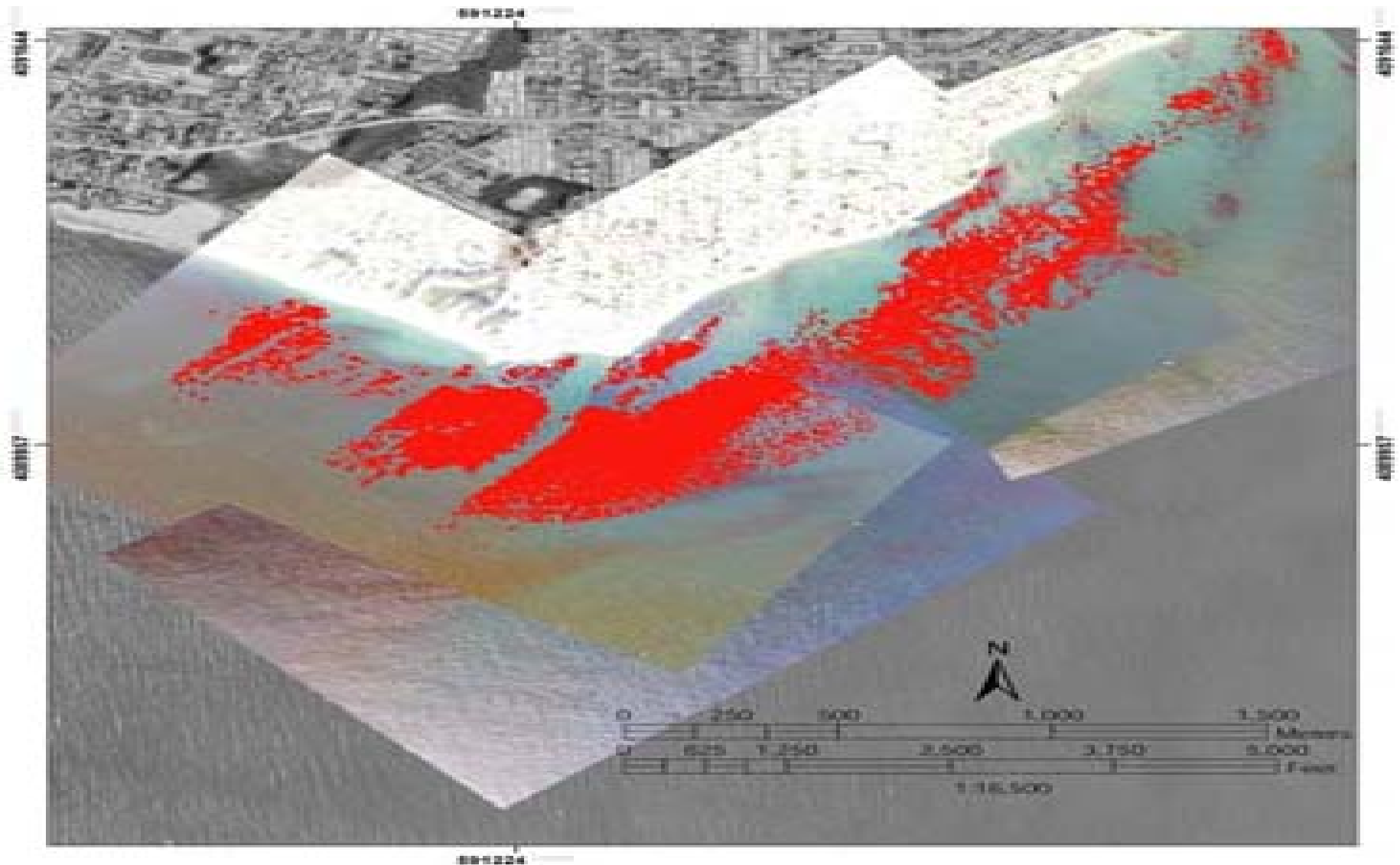


Stillwater Cove Dive Site 4Oct02

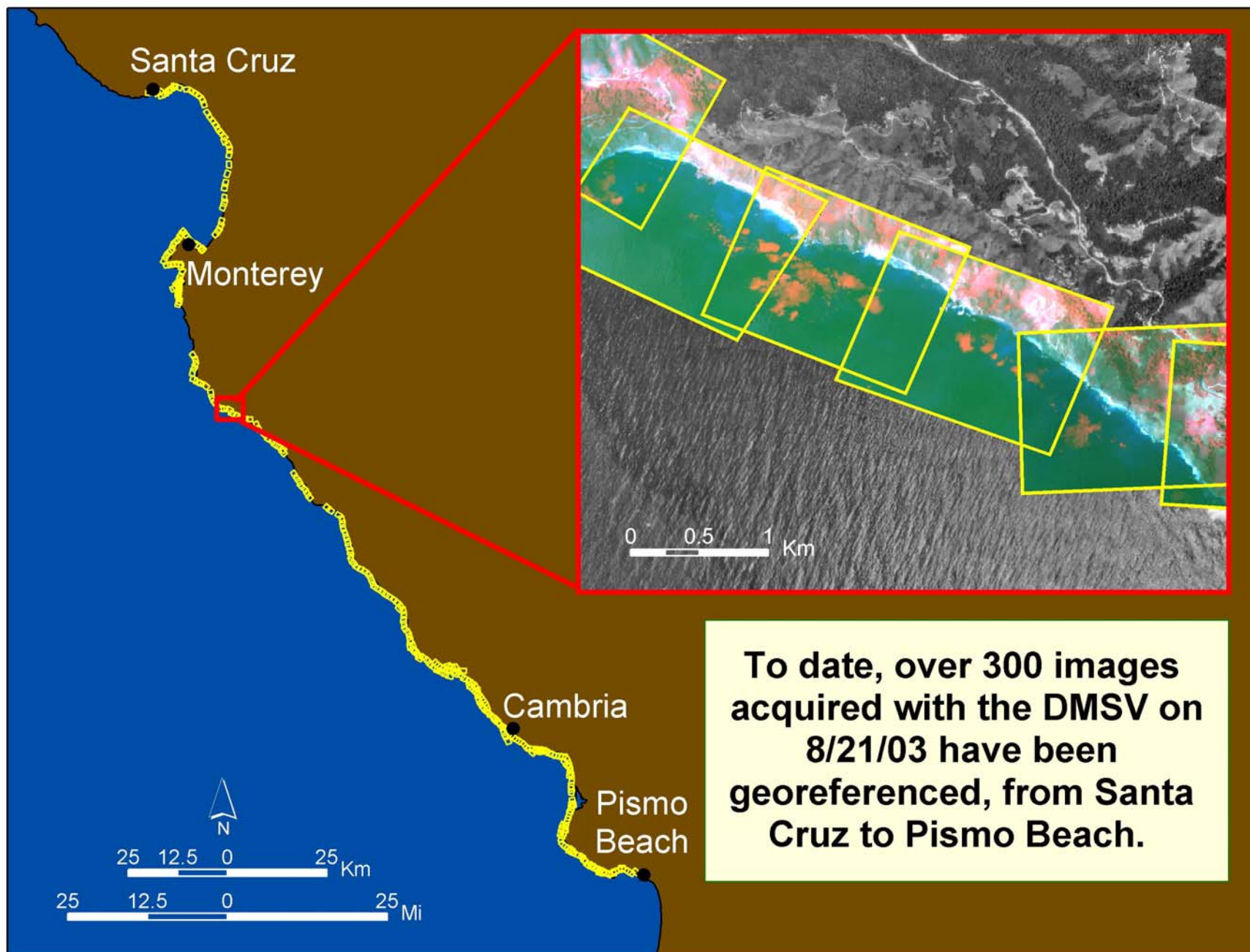




Lucas Pt. Kelp DMSV 4Oct02



Soquel Pt. Kelp 4Oct02  
(classified IR image+true color)

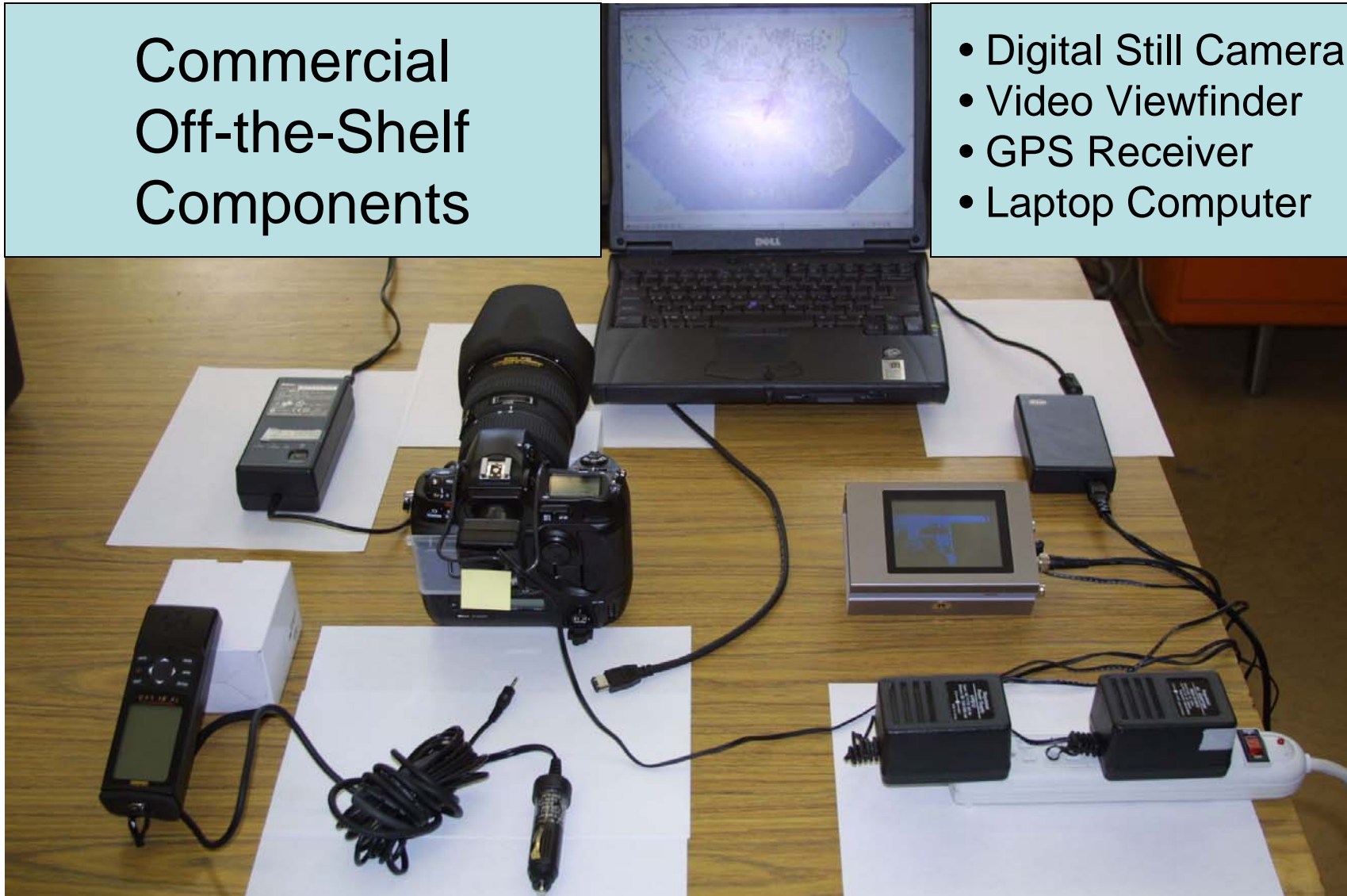


- **Kelp Mapping** : Digital Multi-Spectral Video
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with Integrated GPS  
  
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# Digital-Still Imaging -- GPS Integration

Commercial  
Off-the-Shelf  
Components

- Digital Still Camera
- Video Viewfinder
- GPS Receiver
- Laptop Computer





# Image with GPS and “Shooting Data” Imbedded (JPG / EXIF 2.2)

Nikon Viewer DSC\_0072.JPG @ 25%

File Edit View Folder Tools Window Help

Shooting Data

Nikon D1X	Focal Length: 28mm	White Balance: Auto	Color Mode: Mode I (sRGB)	Latitude: N 38° 31' 5.4"
2003/03/19 14:32:17.0	Exposure Mode: Shutter Priority	AF Mode: AF-S	Hue Adjustment: 0°	Longitude: W 121° 29' 55.8"
JPEG (8-bit) Fine	Metering Mode: Multi-Pattern	Tone Comp: Normal	Sharpening: Normal	Altitude: 9.00 m
Image Size: Large (3008 x 1960)	1/1000 sec - f/5.6	Flash Sync Mode: Not Attached	Noise Reduction:	
Color	Exposure Comp.: 0 EV		Image Comment:	
Lens: 28-70mm f/2.8-2.8 D	Sensitivity: ISO 640			

Date / Time Stamp

GPS  
Lat / Lon  
Altitude

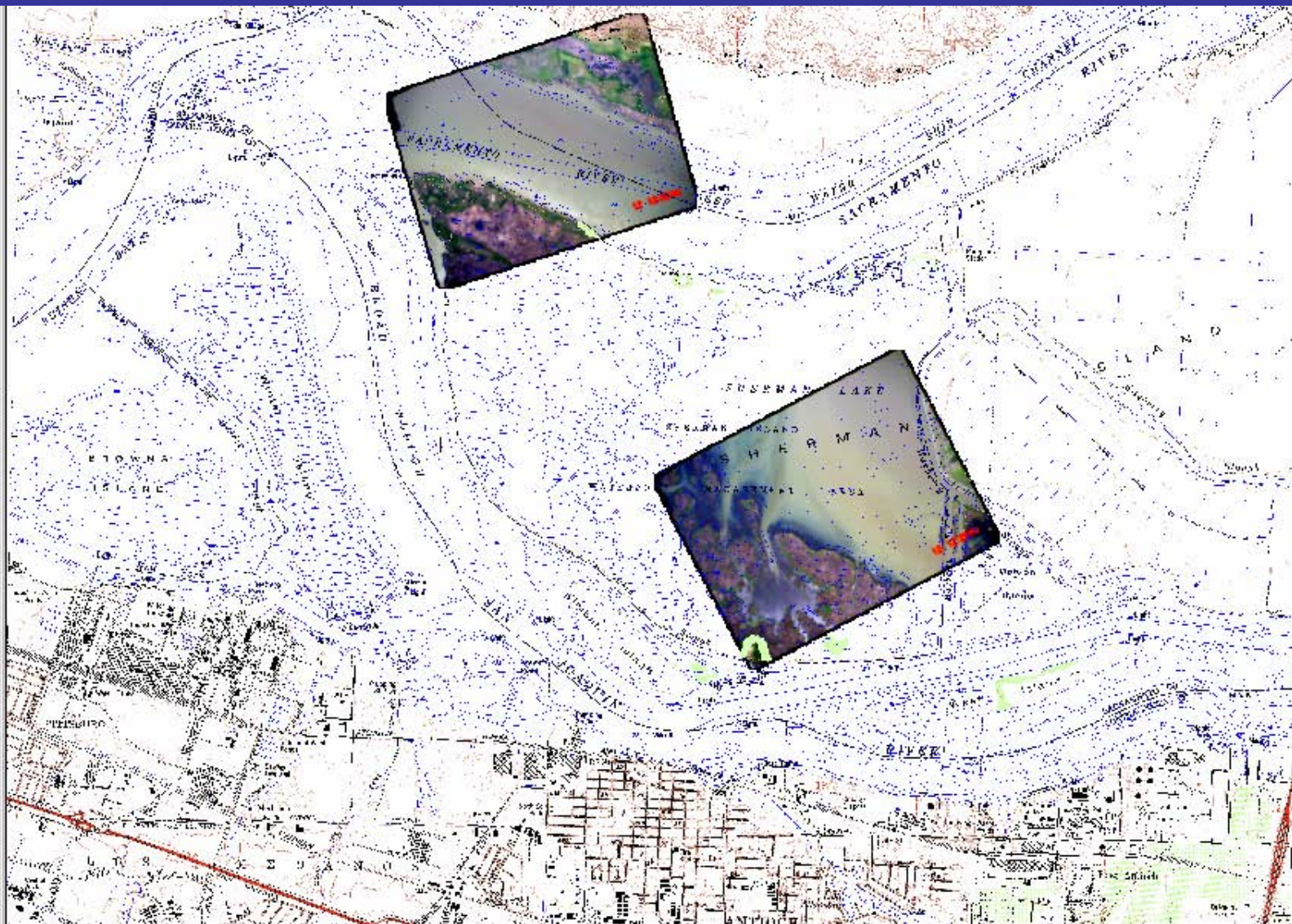




## Multiple GPS Units: Navigation and Flight Track Recording




# Georeferencing : ArcView 3.x and ArcGIS 8.x





06	↔
19	↑



- 
- The map displays the Sacramento-San Joaquin River Delta, a complex network of waterways and land. The Sacramento River flows from the top right, and the San Joaquin River flows from the bottom left. Key features include the Sacramento-San Joaquin River Delta, the Sacramento-San Joaquin River, the Sacramento-San Joaquin River, and the Sacramento-San Joaquin River. A yellow outline highlights a specific area within the delta, likely the site of the proposed project.



# Image Enhancement

333.09

718.38

- ☐ T38121a7.tif
- ☐ New\_ds c00946 .im  
Res: 1:1.5  
:Layer\_1  
:Layer\_2  
:Layer\_3
- ☒ New\_ds c00932 .im  
Res: 1:1.5  
:Layer\_1  
:Layer\_2  
:Layer\_3
- ☒ New\_ds c00933 .im  
Res: 1:1.5  
:Layer\_1  
:Layer\_2  
:Layer\_3
- ☒ New\_ds c00934 .im  
Res: 1:1.5  
:Layer\_1  
:Layer\_2  
:Layer\_3
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Res: 1:1.5  
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Res: 1:1.5  
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:Layer\_3
- ☒ New\_ds c00939 .im  
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:Layer\_1  
:Layer\_2



- **Kelp Mapping :** Digital Multi-Spectral Video

- **Incident Response :** Digital-Still Imaging  
with Integrated GPS

Georeferencing

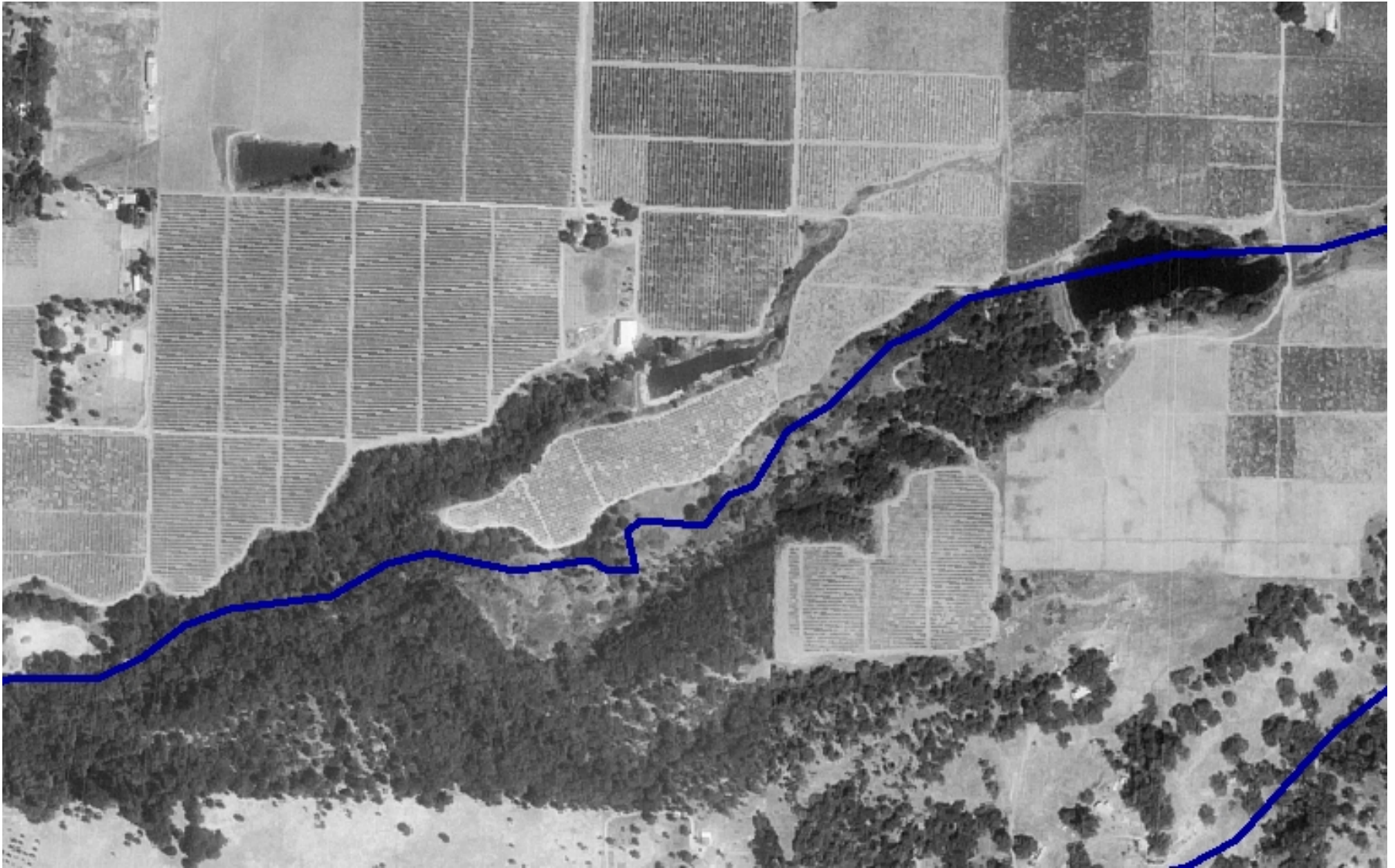
- **Code Enforcement :** Change Detection

- **Response Planning:** Video / GPS Recon



# Change Detection -- Stream Alteration

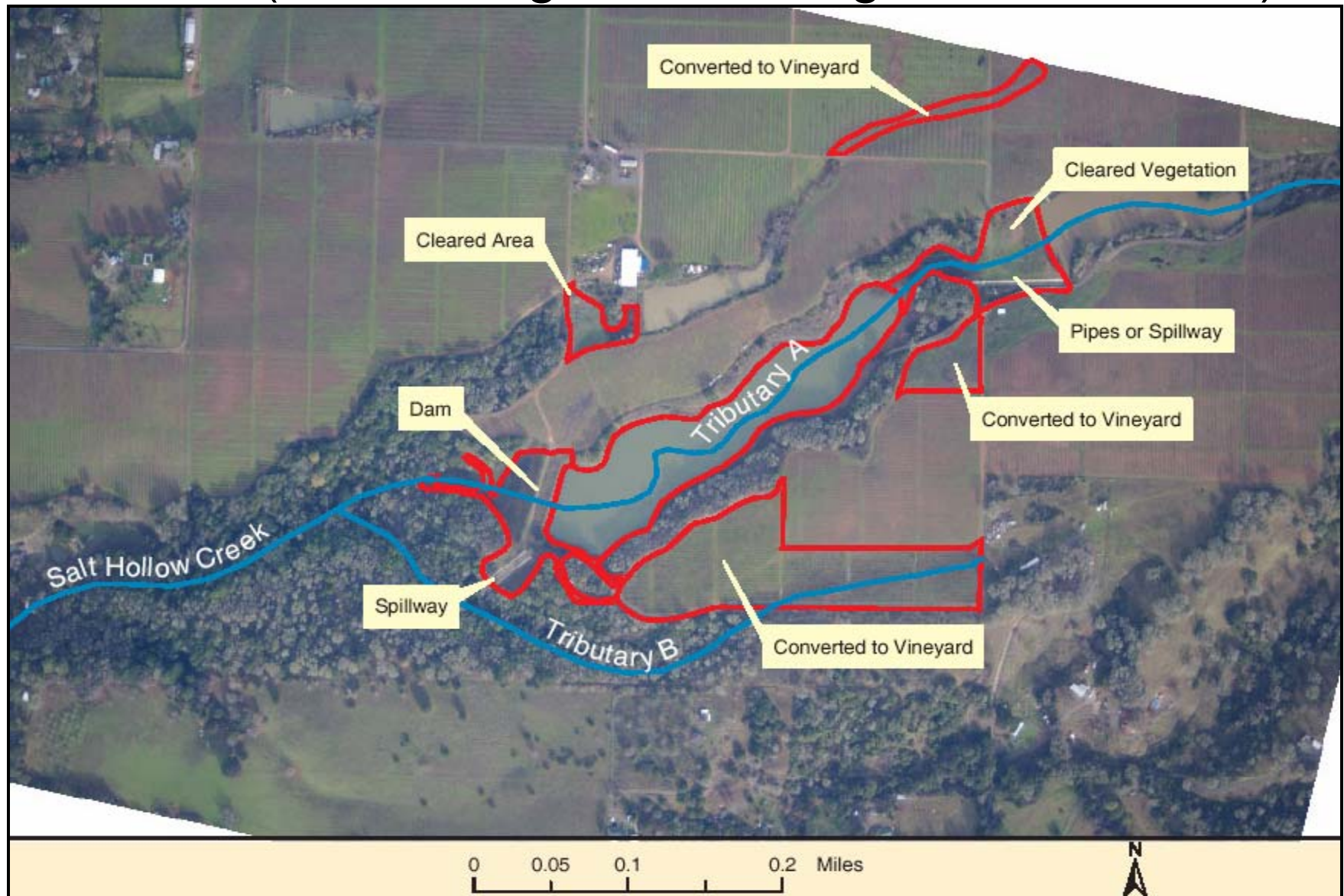
## **Time 1 (USGS DOQ)**





# Change Detection -- Stream Alteration

## Time 2 (OSPR Digital Still Image, 3008 x 1960)



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# GPS-Time Encoded Video



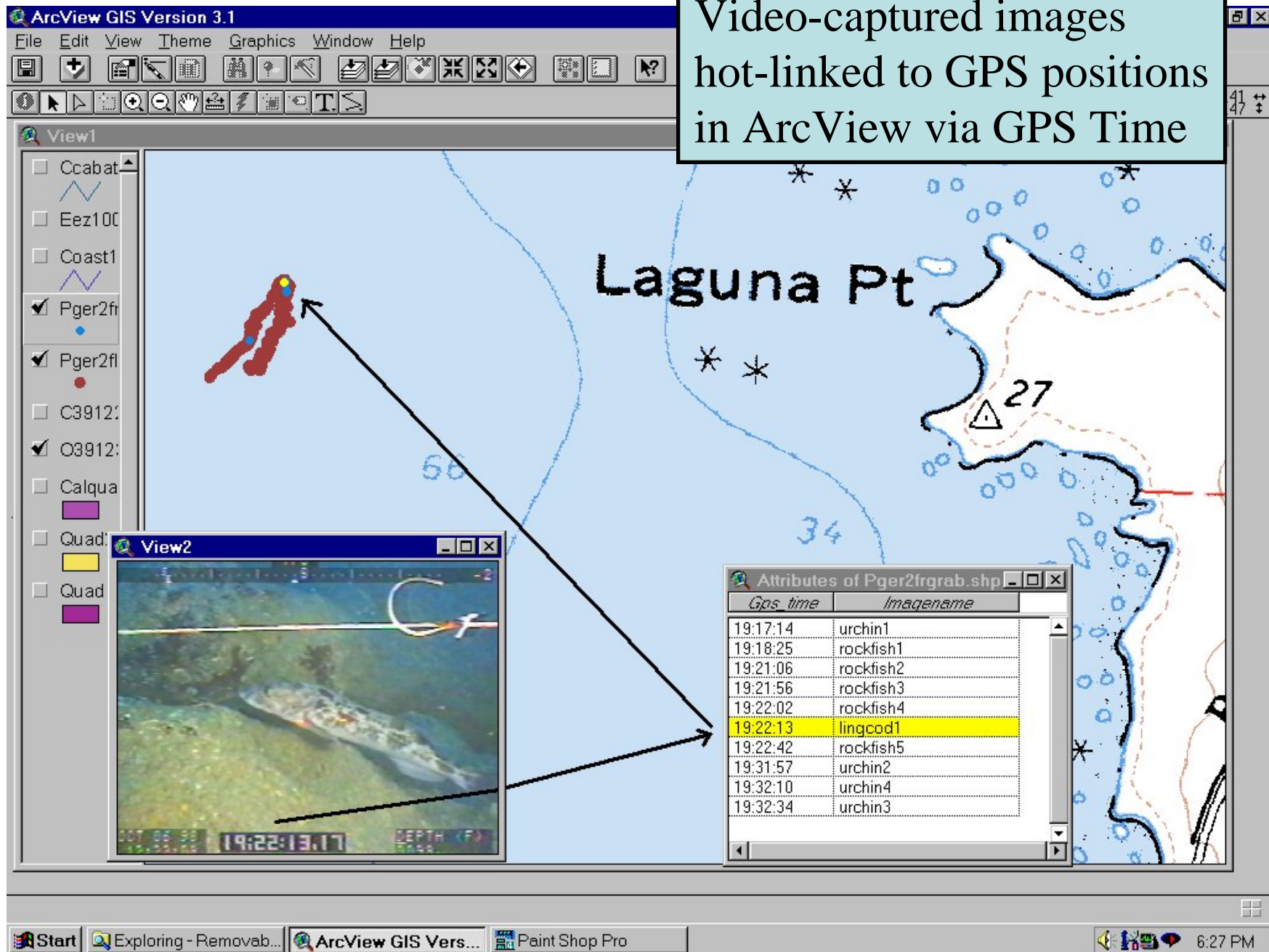


# Video Event Log / Time Index

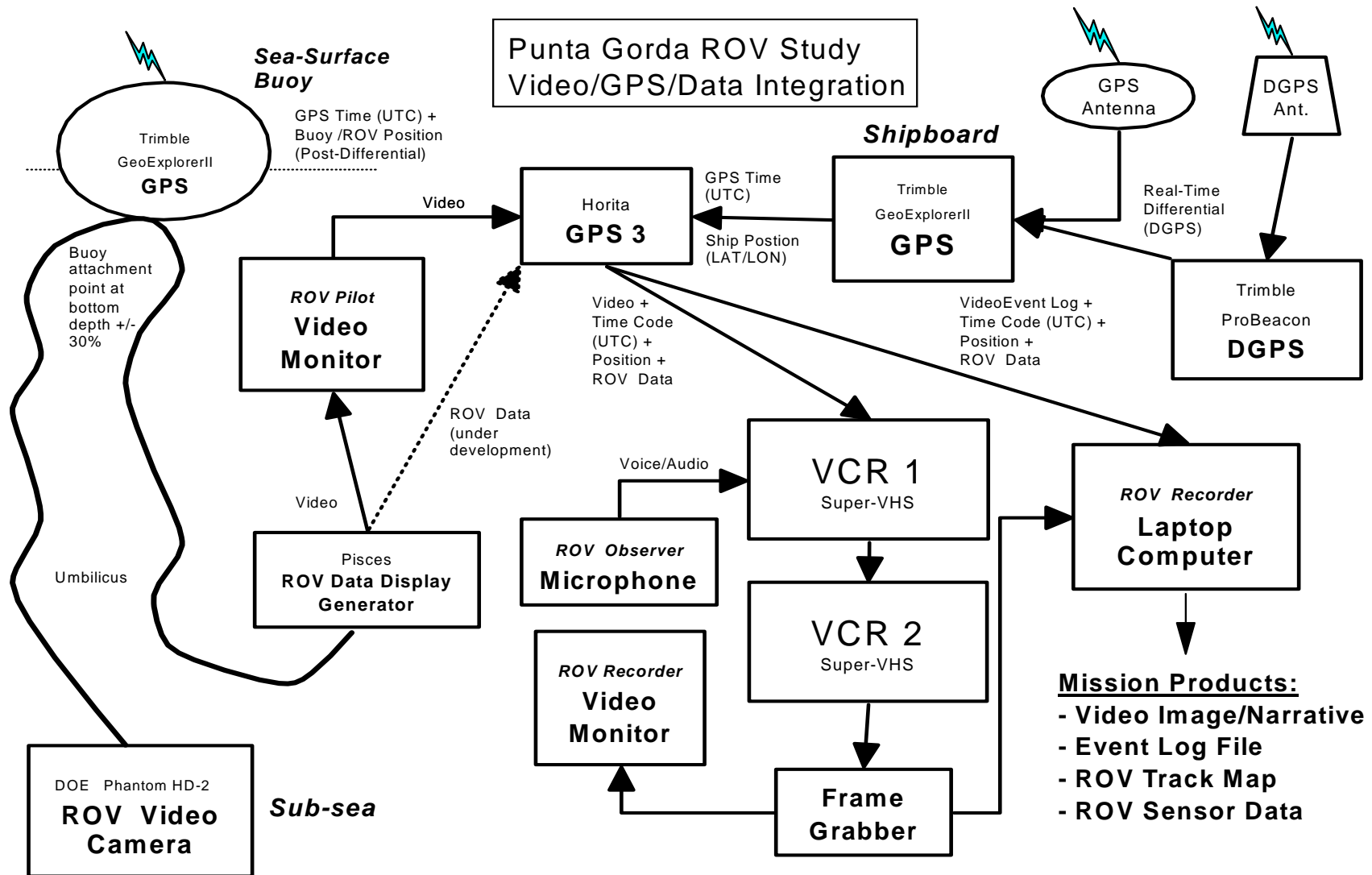
LOG			=== Horita PC-LOG(tm) G1.18 ===			Help		
PRODUCTION						SHOOT		
Title: OSPR Shoreline Aerial Recon			Date: 1998-04-27					
Number: 8			Location: SF Bay Area Shoreline					
Producer: CA Dept. Fish and Game			Crew: B.Morgan;J.Hardwick;P.Veisz					
Note: Office of Spill Prev. & Response			Lat: 0:00.000 N Lon: 0:00.000 E					
TAPE						LOG		
Reel #:		Format: Mini-DU		Date: 20030827		By: pveisz@dfg.ca.gov		
Tape #: 8		Length: 60 min		Disk #:		File: ospr_8dv.log		
COM1 00:00:00:00 00:00:00			Messages: EDITING LOG...					
LINE	TC	LOCATION	DURATION	COMMENTS			DROP FR	
			===== Tabs			!T-----T-----T-----T-----T-----T-----T-----		
1	18:51:33;11	00:18;15		LAT: 37:49.014 N LON: 122:19.243 W				
2				intro pveisz; begin east end bay bridge				
3		00:32;13		LAT: 37:49.115 N LON: 122:19.755 W				
4				lots of debris at foot of bridge; w: 43				
5	18:52:24;11	00:31;07		LAT: 37:49.570 N LON: 122:19.556 W				
6				alt 500 feet agl; cam 1/1000 sec; max wide zoom				
7	18:52:55;18	00:14;22		LAT: 37:49.758 N LON: 122:19.111 W				
8				sandy beach				
9	18:53:10;12	00:46;06		LAT: 37:49.700 N LON: 122:19.107 W				
10				repeat intro; flight date 4/27/1998; see also VHS				



Video-captured images  
hot-linked to GPS positions  
in ArcView via GPS Time



# GPS/Imaging Technology Transfer – Airborne / Seaborne





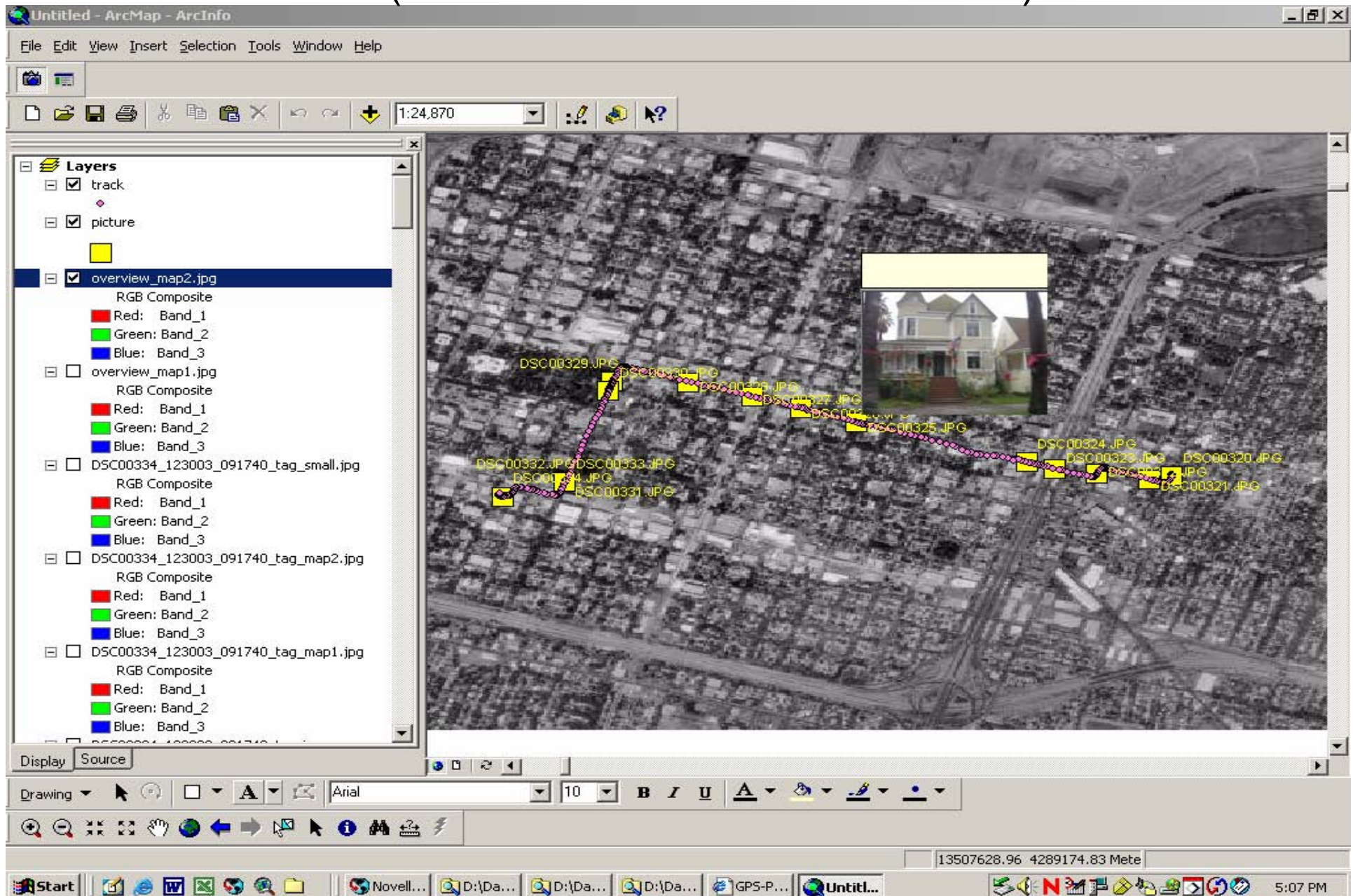
# Conclusions

- GPS Integration provides Unique Identifiers for all observations
- GPS Integration provides tightly coupled positions to all observations
- GIS and Imaging technologies enable mapping and integration of key knowledge for Incident assessment and response

# Future Developments

- Wireless connectivity – Field Data  
(ESRI ArcPad)
- GPS / Imaging / GIS Web Services  
(ESRI ArcGIS / GPS-Photo Link)
- Electronic Map & Metadata Publication  
(ESRI ArcIMS, ArcPublisher/ArcReader)

# GPS / Imaging / GIS Web Services Integration (ESRI ArcGIS / GPS-Photo Link)



# Acknowledgements

- DFG Air Services Branch
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- DFG Information Technology Branch  
GIS Service Center
- DFG Office of Spill Prevention and  
Response GIS Unit

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The mission of the California Department of Fish and Game is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public.